in the Carrara marble. In six other cases the structures bore certain analogies to those in the deformed rock but were of doubtful origin, while in the remaining twenty the structure was different.

The following is a summary of the results arrived at:—

1. By submitting limestone or marble to differential pressures exceeding the elastic limit of the rock and under the conditions described in this paper, permanent deformation can be produced.

2. This deformation, when carried out at ordinary temperatures, is due in part to a cataclastic structure and in part to twinning and gliding movements in the individual crystals comprising the rock.

3. Both of these structures are seen in contorted limestones and marbles in nature.

4. When the deformation is carried out at 300° C., or better at 400° C., the cataclastic structure is not developed, and the whole movement is due to changes in the shape of the component calcite crystals by twinning and gliding.

5. This latter movement is identical with that produced in metals by squeezing or hammering, a movement which in metals, as a general rule, as in marble, is facilitated by increase of temperature.

6. There is therefore a flow of marble just as there is a flow of metals, under suitable conditions of pressure.

7. The movement is also identical with that seen in glacial ice, although in the latter case the movement may not be entirely of this character.

8. In these experiments the presence of water was not observed to exert any influence.

9. It is believed, from the results of other experiments now being carried out but not yet completed, that similar movements can, to a certain extent at least, be induced in granite and other harder crystalline rocks.

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"Lines of Induction in a Magnetic Field." By H. S. Hele-Shaw, F.R.S., and A. Hay, B.Sc. Received June 13,—Read June 21, 1900.

(Abstract.)

When a viscous liquid flows in a thin layer between close parallel walls, the motion takes place along stream-lines identical with those of a perfect liquid. The course of the stream-lines may be rendered evident by injecting into the clear liquid thin bands of coloured liquid.

If the thickness of the liquid layer be varied, then there will be a decrease of resistance to the flow wherever there is an increase of

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thickness. As a consequence, there will be a convergence of the stream-lines on the area of greater thickness.

When experiments with liquid layers of variable thickness were first tried, a general resemblance was noticed between the stream-lines so obtained and the lines of induction due to the presence of a permeable substance in a uniform magnetic field.

The main object of the present paper was to investigate accurately whether complete correspondence between the two cases really existed, and, should correspondence be established, to apply the method to the solution of a number of two-dimensional magnetic problems. The investigation thus involved—

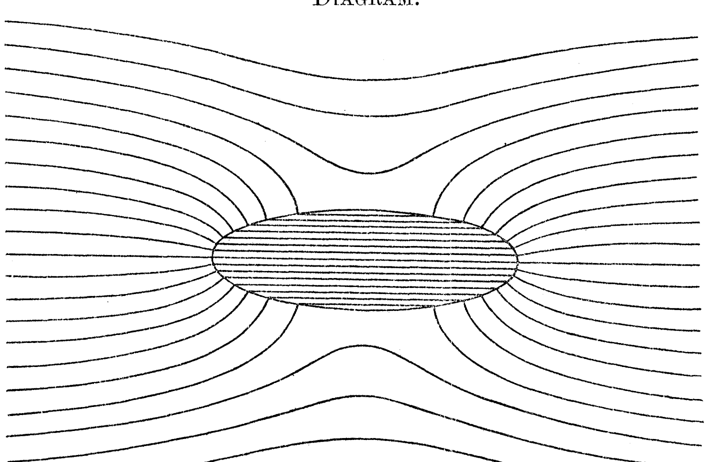
(1) A mathematical treatment of the subject, by means of which plotted diagrams could be obtained for comparison with experimental results.

(2) The construction of apparatus capable of giving exact results which could be photographed.

(3) The investigation of the laws connecting the rate of flow with the thickness of film of the liquid used.

The theoretical case selected as a test case was that of an elongated elliptic cylinder placed with its major axis along the field, the permeability being assumed to be 100. The lines of induction for this case are shown in the accompanying diagram, and were calculated and plotted by the method explained in the paper.

DIAGRAM.



If, for the moment, we assume that the liquid stream-lines are identical with lines of magnetic induction, then the following correspondence between the two cases holds :—

| *Liquid Flow.* | *Magnetic Induction.* |
| --- | --- |
| (*a*) Pressure gradient. | ($\alpha$) Magnetic intensity or force. |
| (*b*) Rate of flow per unit width of liquid layer. | ($\beta$) Magnetic induction. |
| (*c*) Ratio of (*b*) to (*a*). | ($\gamma$) Permeability = ratio of ($\beta$) to ($\alpha$). |

From this it is evident that the permeability corresponding to a given ratio of thicknesses of the liquid layer is given by the ratio of the rates of flow, per unit width of layer, for the two thicknesses, assuming the same pressure gradient for both. The connection between the rate of flow and the thickness for a given gradient of pressure was carefully investigated in a series of preliminary experiments, and it was found that the rate of flow varied as the *cube* of the thickness—a result which was afterwards confirmed by a theoretical investigation. The permeability in the magnetic problem is thus given by the ratio of the *cubes* of the two thicknesses.

A stream-line diagram corresponding to the theoretical diagram given above was next obtained, and on superposing the two it was found that their lines were practically coincident.

The soundness of the method as applied to two-dimensional problems in magnetic induction having been thus established, the authors proceeded to apply it to a number of special cases, many of which could not be successfully attacked by any other method. The paper is accompanied by a large number of photographs, showing the results obtained. Some of these are of importance from an electrical-engineering standpoint.

The method described is the only one hitherto known which enables us to determine the lines of induction in the substance of a solid magnetic body. It is equally applicable to two-dimensional problems in magnetic induction, electrical flow, and heat conduction.

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"The Distribution of Molecular Energy." By J. H. Jeans, B.A., Scholar of Trinity College, and Isaac Newton Student in the University of Cambridge. Communicated by Professor J. J. Thomson, F.R.S. Received June 14,—Read June 21, 1900.

(Abstract.)

This paper attempts to examine the well-known difficulties in connection with the partition of energy in the molecules of a gas. A definite dynamical system is first considered, an ideal gas in which the molecules are loaded spheres, that is, spheres of radius $a$, of which the centre of mass is at a small distance, $r$, from the geometrical centre. It